LWD 1

Encoding & Decoding

TRANSMISSION SEQUENCE

- Flow begins
- Probe is powered up
- 30 second warm up period
- Running pulses start
- Probe controls the solenoid to actuate poppet
- Poppet restricts flow area creating a positive pressure
- Pulse is transmitted at about 4000 ft/sec
- Pulses are measured by the transducer and encoded by the surface computer via the barrier box

MUD CIRCULATING SYSTEM



MUD CIRCULATING SYSTEM



DATA ENCODING / DECODING

• Encoding:

- Manchester (more reliable)

• Decoding:

- Algorithm M12 (NEW)
- Algorithm Double Level Threshold (DLT)

Manchester Encoding

- Encoding is how the data is written
- It Defines 0's & 1's with positive pulse pressure surges.



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BIT

- Smallest Piece of Information
- Either data bits or parity bits

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- Bit is either 0 (Low to High) or 1 (High to Low)
- Like letters of alphabet (,b,c,...)



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WORD

- Word is a piece of information (Inclination, Azimuth, toolface, etc)
- Made of 5 Bits (shortest) up to 13 Bits (longest)
- Word contains data bits and one even parity bit.
- Parity bit will be added Downhole before transmitting the word to be valid for detection.
- Parity Bit will be 0 if the number of 1's in data bits is devisable by 2, otherwise it will be 1.
- Word is valid for encoding only if passed parity check.



Even parity: Sum of 1's in a word is an even number

BLOCK

- A group of words in a specific sequence
 - (i.e. Survey, Toolface list)
- Always Begins with a Flag/Tag Sequence
 - Synchronizing Surface Computer with probe

TRANSMISSION SEQUENCE



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Flag

- Synchronizes surface computer with down hole probe.
- Made up of 0 1 1 1 1 1 1 0 (double high, 5short pulses and double low).
- Surface computer halts pervious detection, identify new block start.
- Defines the start of decoding (0's & 1's) as all the running pulses are zeros (10 for 0.5 Hz & 16 for 0.8 Hz).
- Begins decoding new tag.





Used for block Identification.
Contains 5 bits, the first is used to identify toolface type : 0 for Magnetic & 1 for Gravity.

X	XXX	X
Toolface	Identitv	Parity
Tvpe	Data	Bit

Toolface

- Contains 7 bits (six data bits + one parity bit).
- Toolface transmission time is 14 sec. At 0.5 Hz.
- Toolface transmission time is 8.7 sec. At 0.8 Hz.

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FREQUENCY

 $Frequency(Hz) = \frac{Cycles}{Second}$ $Transmission(Hz) = \frac{Pulses}{Second}$ $Data Rate(Hz) = \frac{Bits}{Second}$

Transmission Frequency

▲ 0 5 (U-)	_ 1Pulse	1 Bit	
♥ 0.5 (HZ)	2Seconds	2Seconds	
▲ 0.9 (Ц ,)	_ 8Pulse	1Pluse(Bit)	
♥ U.0 (ΠZ)	- 10Seconds	 1.25 Seconds	

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MANCHESTER ENCODING



Low to High Pressure Change (Voltage) Represents a "0"

MANCHESTER ENCODING



High to Low Pressure Change (Voltage) Represents a "1"

MANCHESTER EXAMPLE



Solenoid
Poppet Extention

Decoding Schemes

Detection Algorithms are :

- Algorithm Double Level Threshold (DLT)
- Algorithm M12 (Mean 12- new)
- Manchester Max (Modified M12)

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Decoding Schemes Algorithm Double Level Threshold (DLT)

- Not a filter but a decision making tool.
- Looks at length of pulse to determine long and short pulses.
- Pressure signal is sampled 64 times per bit,
 Short Pulse < 48 > Long Pulse
- Long pulse means change :-

-Long High means change from 0 to 1 -Long Low means change from 1 to 0

So pulses before or after can be sorted.

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D. L. T.



Decoding Schemes Algorithm M12 (new)

- •Evaluates the pulse by looking at the slope change during the second half.
- •A positive slope is a "0"
- •A negative slope is "1"
- •it is helpful when receiving too many reflections.

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Transmitted Surveys FULL SURVEY

Probe transmits

- –Gx
- –Gy
- –Gz
- –Bx
- –By
- –Bz
- –Dmt

•Surface computer calculates –Inclination –Raw Azimuth

- -Absolute Azimuth
- -Gtotal
- -Btotal
- –Dip

-Az_{a-r} Transmission time is about 2.5 times longer than Short Survey

SHORT SURVEY

- Probe transmits
 - Inclination
 - Raw Azimuth
 - Gtotal
 - Dmt
- Short Collar Solution CANNOT be used
 - Probe must be properly spaced in NMDC
- No magnetic interference present

Note: Short survey is best used when experiencing detection problems

DRILL STRING INTERFERENCE



SHORT COLLAR SOLUTION

- Corrects azimuth for magnetic drill string interference

 Bz is corrupted
- Mathematically iterates a Bz using theoretical DIP and Btotal
- Calculated downhole or surface computer
 - DEPII/PCD/DM

SHORT COLLAR LIMITATIONS

- Cannot correct for cross-axis magnetic interference
- Need accurate DIP and Btotal for location
- Must have accurately calibrated probes
- Must have stable sensor readings

Probe Operations Directional Only Modes

- Steering Modes :- 1, 2, 4, 5, 6, 8
- Used with steerable BHA
- Will transmit surveys and toolfaces continuously
- Survey Only Modes :- 3, 7
- Used with rotary BHA
- Will only transmit three surveys then cease pulsing

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Pumps Up Steering Survey

Available with Modes 1, 2, 4 or with PU Tag(CDS) Survey sampled and stored during transmission of second TF

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Pumps Up Rotary Survey



time-

Available with Modes 3 & 7 or with PU Tag(CDS)
Survey sampled and stored during transmission of Tag.

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Pumps Down Survey

Available with Modes 5-8 or with PD Tag(CDS) Drill string is held still for 60 sec. before turning pumps off Survey is sampled and stored 20-25 sec before pumps off to avoid reactive torque.

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Pumps Off Survey

Survey taken with battery in Modes 5-8 with PD Tag Survey sampled and stored 30 sec. after pumps off Drill string is held still 45 sec. after pumps off

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Custom Data String CDS Mode(PCD,DEPII)

sinission Paraliteters [LIST 1] LIST 2] SRS [Slim Phase 4 Recorded [DDs	S PWD SLD FABI FCIN FWOB
ransmission Parameters Setup	
General parameters	Survey parameters
Data Rate 1 0.5 (Manchester)	Current borehole azimuth
Data Rate 2 0.8 (Manchester) 💌	Current borehole inclination 0
Wait Period (15-90 secs)	Wellsite latitude (deg.min)
Run-In Period (15-90 secs) 25	Telemetry type
Error Alarm Transmission Period (1-60 min) 30	Data Rate 1
	Data Rate 2
Toolface Magnetic to Highside Switch (0.0-16.0 Deg, 0 for HS only) 5	

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CDS Mode

		101 2 01					
Preamble Loop							
ROP 1000.00 EWR-Extra Shallow EWR-Shallow EWR-Medium EWR-Deep Gamma Temperature Toolface Inclination Shott Collar Azimuth Long Collar Azimuth	Secs 0.50 0 0 0 0 0 0 0 0 0 0 0	/Sample 0.80 0 0 0 0 0 0 0 0 0 0	Sampl 0.50 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	es/Ft 0.80 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	Max ROF 0.50 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	P @ 1 Sample/Ft 0.80 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	Flag condition PD Pumps Down PU Pumps Up Directional Parameter IDs GX GY GZ Gravity vectors BX BY BZ Magnetic vectors RM Impeller rpm TM Probe temperature TF Automatic Toolface IN Downhole Inclination SC Downhole Short Collar Azimuth LC Downhole Short Collar Azimuth LC Downhole Short Collar Azimuth GT Gravity Total HS Raw Probe Gravity Toolface BM Btotal measured BC Btotal calculated Gamma Ray ID GR Dual Gamma Ray Resistivity IDs XP Extra shallow phase EWR SP Shallow phase EWR DP Deep phase EWR DP Deep phase EWR DP Deep phase EWR DP Deep phase EWR AL At Bt Inclination Battery IDs SP Shaltow shallow
Download Update	e Detection						OK Cancel Apply + Test

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MUD CIRCULATING SYSTEM DAMPENERS



MUD CIRCULATING SYSTEM



TRIPLEX PUMP

